Monthly climate variation over Korea in relation to the two types of ENSO evolution

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ENSO impact on East Asian climate

- ENSO exerts significant impacts on East Asian climate → ex) El Nino developing phase – reduced PRCP in N. China
- Regional T & P are different among individual ENSO event due to inter ENSO-diversity

Differences in ENSO evolution

- El Nino onset (Yr1)- Transition El Nino-La Nina (Yr2)-persistent La Nina (Yr3)
- El Nino onset (Yr1)- El Nino or neutral (Yr2)
Group 1: development of El Nino, transition to La Nina and persistence of La Nina
- Atmosphere → propagate eastward during developing and decaying phase of El Nino, standing feature from mature phase of La Nina / Positive PRCP anomaly is related to westerly anomaly/ Negative PRCP anomaly occurs over low-level divergence region

Group 2: mature phase of El Nino is delayed by about 2 month relative to the first group
- Location of maximum warming is over tropical central Pacific
- Strong easterly anomaly over western Pacific is key factor for transition from El Nino to La Nina → no clear easterly wind over the western Pacific
Monthly Temp. and Prcp. anomaly over Korea for group1

- Composite anomalies for monthly T&P for group1
- El Nino developing Yr1
  - generally warmer than normal
    - February, October, November
  - wet: May, November, dry: March, September
- Transition Yr2
  - positive T: August-October, Negative T: November
  - Some linear relationship: warm (cold) in El Nino (La Nina) peak phase
  - wet: March, September, dry: November, December
- PRCP September, November → opposite anomalies for Yr1 and Yr2 → some linear response
- La Nina Persistence Yr3
  - In spite of similar La Nina structure bt Yr2 & Yr3
  - Korean climate shows distinctively different anomalies
    → non-linear response of Korean climate to La Nina
Yr2 and Yr3 November → Share common feature of La Nina structure
Yr2 (La Nina developing) → low pressure anomaly over North Pacific → Korea is affected by cold and dry air advection from northerly flow
Yr3 (La Nina persistence) → high pressure anomaly over North Pacific → Korea is affected by high pressure anomaly → warm condition
Different atmospheric response → convective activity over tropical western Pacific for Yr3 is weaker than Yr2
Monthly Temp. and Prcp. anomaly over Korea for group2

- Composite anomalies for monthly T&P for group2
- El Nino developing Yr1
  - generally cold anomaly for second half of Yr1
  - wet: August, December, dry: November
- El Nino persistence or neutral Yr2
  - positive T: December
  - wet: April, November
- In spite of same El Nino developing phase, Korean T & P shows significant difference for group1 and group2

- August \(\rightarrow\) Group1: warm & dry
  Group2: cold & wet
- November \(\rightarrow\) Group1: warm & wet
  Group2: cold & dry
Group1&Group2 Yr1 November $\rightarrow$ Similar El Nino feature
Maximum warming center $\rightarrow$ Tropical eastern Pacific for Group1/ tropical central Pacific for Group2
Group1 $\rightarrow$ high pressure anomaly over North Pacific $\rightarrow$ Korea is affected by southerly wind $\rightarrow$ warm and wet condition
Group2 $\rightarrow$ low pressure anomaly over North Pacific $\rightarrow$ Korea is affected by northerly wind $\rightarrow$ cold and dry condition
Differences in the convective activity over the tropical western Pacific $\rightarrow$ group1 shows much stronger and well organized suppressed convection over the tropical western Pacific than group2
2018 ENSO activity and outlook

- El Niño developing phase in 2018 Fall
- CPC/IRI predicts 70~75% El Niño state in winter 2018/19
- Warming center is located over tropical central Pacific
- It is not quite sure that current state of El Niño belongs to which ENSO evolution group
2018 ENSO activity and outlook

✓ 2018 October, Korea experienced colder than normal Temp. (Korean Oct. Temp. have warming trend)
✓ El Nino developing year of group2, Korea Temp tends to be colder than normal in October
✓ Composite pattern closely resembles current atmospheric and oceanic state
✓ We should consider ENSO evolution diversity to investigate the ENSO influence on Korean climate
Summary and conclusion

✓ The effect of ENSO on Korean climate is marginal and it varies with the diverse features of ENSO event

✓ Korean climate variability in relation to the two different ENSO evolution process

✓ Group1 → development of La Nina following to the El Nino onset year, La Nina persists in the subsequent year
  
  T & P anomalies over Korea differ between the La Nina developing phase and La Nina persistence phase although they share similar SST structure in the tropical eastern Pacific

✓ Group2 → prolonged El Nino or neutral conditions after the mature phase of El Nino
  
  Differences in the Korean climate between the El Nino developing year for the first and the second groups

✓ These non-linear response of Korean climate to the various evolution stages of ENSO cannot be identified from the linear techniques such as regression analysis or EOF analysis
THANK YOU
Table 2. The set of years used in the composites for the first group from Year1 to Year3 (left column) and the second group of Year1 and Year2 (right column). The years not included in the composites based on the MME dataset are set italics.

<table>
<thead>
<tr>
<th>First group</th>
<th>Second group</th>
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<tbody>
<tr>
<td>Year1</td>
<td>Year1</td>
</tr>
<tr>
<td>Year2</td>
<td>Year2</td>
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<tr>
<td>Year3</td>
<td></td>
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- 1982  1983  1984
- 1988  1989
- 1997  1998  1999

- 2002  2003
- 2004  2005
- 2006  2007  2008
- 2009  2010  2011

- 1986  1987
- 1991  1992
- 2014  2015
Monthly Correlation Coefficient (1979–2015)

a) Nino3.4 & Korea Temperature

95% significance level

b) Nino3.4 & Korea Precipitation

95% significance level